CENTRAL INTELLIGENCE AGENCY

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SECRET
SECURITY INFORMATION

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THE SOURCE EVALUATIONS IN THIS REPORT ARE DEFINITIVE.
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25 YEAR RE-REVIEW

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2. Although research projects originated with the Commission, the actual planning was left entirely to the discretion of German technical personnel. Plans submitted by them were readily approved, and funds, apparently of unlimited quantity, were made available immediately. Most of the equipment necessary for their activities was selected from Peenemende by [redacted] a special Soviet group, headed by SOKOLOV, an Artillary General. 25X1

3. Of primary interest to the Soviets at this time was the utilization of the vast store of German rocket materials suddenly made available to them by the war's end. They were faced with the question: "How good is this material and how long will it remain usable?" Also of interest was the use of T-stoff (80% Hydrogen Peroxide) and its applications, not only to rockets, but to submarines, and submarine torpedoes, the further development of Germany's hypergolic fuels, and storage of these materials until demands for their use occurred. [redacted] 25X1

4. Fuels and oxidizers investigated at GEMA were from old German stocks; therefore, much of the information contained in this report is history. [redacted] 25X1

T-STOFF DECOMPOSITION:

5. [redacted] the development of a T-stoff decomposition catalyst [redacted] criterion of performance, [redacted] the following standards: 25X1

a. One weight unit of catalyst should decompose 100 weight units of T-stoff. (One kilogram of the German V-2 catalyst, potassium permanganate, had been capable of decomposing only 13 kilograms of T-Stoff).

b. Rate of reaction should remain constant throughout the decomposition.

 [redacted] 25X1

c. Weight loss of 1 unit of catalyst should not exceed 10% after decomposing 100 units of T-Stoff.

d. Volume and quality of steam actually produced should not vary from the theoretical by more than 10%.

6. As a means of studying the capabilities of the various catalysts devised, a test apparatus was designed [redacted] for the Commission and built at ASKANIA in Berlin-Toltow. 25X1
/See Enclosure (A)_7. It was a simple reaction chamber fitted with a sieve-like, removable sleeve, catalyst holder. Hand operated valves were used to control the flow of fluid.

7. Twenty grams of the material were prepared and placed in the reaction chamber and two hundred grams of T-Stoff were charged to the tank and pressurized to 50 atmospheres. A regulator maintained this pressure throughout the test. Weight loss of the catalyst during decomposition of the first 200 grams of T-stoff was limited to 5%. If less than this, and considering that the requirements of steam volume, reaction rate, etc., had been satisfactorily, fulfilled, a second test using 50 gms catalyst and 5 kg peroxide was conducted. In this second test, the weight loss was limited to 10%. [redacted] this requirement 25X1
of extreme importance because of the attrition and clogging that had sometimes occured in turbine blades of the V-2 when more easily eroded catalysts were used.

8. The following measurements were made during the tests:

a. Pressure in reaction chamber
b. Temperature in reaction chamber
c. Volume of steam produced
d. Time required for T-stoff tank to empty

9. [redacted] 25X1

PREPARATION OF DECOMPOSTION CATALYST:

10. [redacted] approximately 60 compounds or combinations of compounds to investigate as potential T-Stoff decomposition catalysts. The two forms which gave the optimum results were (a) pellets made with manganese dioxide (MnO_2), lead oxide (PbO_2), and bound with [redacted] cement, and (b) a lead oxide film deposited on conical holders. 25X1 25X1

11. In the pellet catalyst, trial and error experimentation indicated that a somewhat spherical, irregular form with a volume of approximately 1 cubic centimeter was the

 [redacted] 25X1

optimum size. MnO_2, PbO_2, and common [redacted] cement were mixed with about 5% water glass and the particles formed by hand, then dried at 100°C for 24 hours. The mixture was approximately 1 part cement and up to 6 or 7 parts of the other two materials, with the percentage of MnO_2 being a little greater. [redacted] 25X1

12. This catalyst worked well at the reaction chamber temperatures (300°C) but was not satisfactory for decomposing a cold solution. To overcome this difficulty and in order to bring the reaction up to a maximum as quickly as possible, the pellets were coated with a cold concentrated water solution of barium permanganate /Ba $(MnO_4)_2$ 7 for one-half hour, then dried at room temperature. Through the quick reaction that occurred once the T-Stoff came into contact with the $Ba(MnO_4)_2$, the temperature of the chamber was raised and the normal reaction between the catalyst and the peroxide proceeded rapidly. The barium compound was used instead of potassium or sodium because of the rapidity with which either potassium or sodium hydroxide (products of the reaction with T-Stoff) attacks aluminum.

13. In the formulation of the second type catalyst, PbO_2 was anodically deposited by a low voltage electrolytical process upon the surfaces of small truncated iron cones. /See Enclosure (B). 7. In order to build up a hard erosion resistant film, the material was deposited from a solution made by saturating water with lead chloride ($PbCl_2$), then diluting it with 30 - 40% acetone.

14. The cones used with this method were truncated near the top and placed over a porous sleeve. T-Stoff entered from nozzles between the cones. Advantages of this type of equipment were its compactness and small weight. This apparatus was designed to fit inside the reaction chamber. /See Enclosure (A) 7

15. [redacted] the specific qualities and quantities of steam produced with these two catalysts [redacted] 25X1 gave the optimum amounts and fulfilled more rigidly the standards [redacted] for a T-Stoff decomposition catalyst. 25X1

ANTIFREEZE PROTECTION FOR T-STOFF

16. One of the few explicit instructions [redacted] from the Soviets [redacted] was to develop low temperature antifreeze protection for T-Stoff. The material, through chemical additions, was to remain in liquid form from 50° down to minus 40°C and was to develop a steam of the same volume and quality as untreated peroxide. The vapors generated, however, did not have to be of the same chemical composition. To accomplish this [redacted] 25X1 compounded a solution in T-Stoff of 5% by weight of 96% ethyl alcohol and 15% by weight ammonium nitrate. 25X1

[redacted] 25X1

17. [redacted] a request for a catalyst capable of decomposing this material from —40° was received. Work was never begun on the development of this material, [redacted] 25X1

ANALYSIS OF TONKA 250:

18. The only other explicit assignment [redacted] was to develop a quick method of analysis for Tonka 250, a fuel whose composition is 50% trimethylamine and 50% meta-xylidine. The analysis method was [redacted] devised [redacted] by Professor WOEBLING, [redacted] 25X1 It consisted of a simple fractionating procedure to separate the two compounds. This was easily done because of a 100°C difference in their boiling points, and determination of the impurities in the meta-xylidine by measuring its crystallization temperature in acetic acid. [redacted] 25X1

HYPERGOLIC FUELS:

19. In order to develop specifications for the formulation of hypergolic fuels, it was first necessary [redacted] to devise a means of measuring the ignition lag of such fuels, i.e., the time interval from initial contact of the oxidizer with the fuel until a maximum burning rate was achieved. 25X1

20. All experiments to measure this ignition lag at GEMA were done at room temperature. [redacted] 25X1 /The World War II German requirement was that fuels should be hypergolic with nitric acid from —40°./ [redacted] 25X1 Design and prints for the construction were completed at Ostashkow, but then removed to Moscow. [redacted] 25X1 Details of this latter apparatus are shown. /See Enclosure (C)./

21. Operating principles of the instrument were as follows: fuel was placed in the lower cylinder and allowed to pass through the connecting tube until a few drops overflowed into a beaker placed under the drain. The recording mechanism and selenium photoelectric cell were turned on. A drop of the oxidizer, 98% fuming nitric acid, was allowed to fall into the filled fuel pan, thereby breaking the light beam which was focused across it and causing a deflection on the recording device. Flame arising from the fuel again interrupted the beam, causing first a small, then a maximum deflection. The interval, as measured from the frequency of a timing cycle also printed upon the recorder, was the fuel's ignition lag. Reproducibility of results was within ±0.005 second.

22. Hypergolic fuels investigated at GEMA are listed below. In each case, the oxidizer with which the fuel was hypergolic was 98% fuming nitric acid. [redacted] did not investigate aniline or hydrazine fuels: 25X1

a. Triethylamine, alone
b. Furfurol, alone
c. Vinyl-n-butylether, alone (German designation: Visol 1A)
d. Tonka 250 (50-50 solution Triethylamine-meta xylidine)
e. Mixtures of Visol 1A with the following, [redacted] 25X1

    (1) Xylol, Toluol, and Optol 10 (compound of pyrocatechol)
    (2) Furfurol
    (3) Xylol
    (4) Kerosene

23. There was no blanket specification established for a general "hypergole". Each fuel was limited by its own physical characteristics. However a requirement was set for each one as to its vapor pressure at 50°C, its color, specific gravity, freezing point, and viscosity at a standard temperature. No minimum was established for heating values because a calorimeter was not available to the laboratory. Tests to determine storage requirements and practices were begun, but only triethylamine was investigated [redacted] They were to have established what impurities developed during storage, how much water could be safely absorbed, chemical and physical change and/or deterioration and what effect these changes would have had on the fuel's hypergolic ability. /The lack of blanket requirements was contrary to the German World War II standards which demanded that if a fuel was hypergolic with nitric acid, it must: 25X1

a. have a freezing point below —40°C and a viscosity at that temperature of less than 10 centipoises
b. be hypergolic at —40°C. [redacted] ignition lag instrument was first designed to operate at room temperature, then later only to —20°C. 25X1
c. meet specific heating valve requirements/

[redacted]

24. Nitric acid storage, which was to have been investigated was prevented [redacted] corrosion inhibitors were never incorporated in the acid either in GEMA or in the USSR.

DRIFT COMPENSATOR:

25. The Soviets presented an old AEG QUERKOPF computer to the research group and asked that it be studied as to its adaptability for use as a drift correction mechanism in missiles. Dipl. Ing. Walter BOOS, a high frequency specialist, was given the problem. The instrument itself was unusable as it was, because of its inability to function at accelerations greater than 1 g, so drawings and calculations to permit its redesign were submitted. Mechanism was basically a rate type computor with contacts which were shifted in proportion to the number of "g's" it was subjected to. [redacted] /See Enclosure (D)/

THRUST REGULATOR:

26. In order to determine the area into which a ballistic missile will fall, it is necessary to know exactly what its thrust will be during every portion of the flight. For this purpose, the Soviets requested [redacted] a regulating device to keep the thrust constant during the entire length of burning. /See Enclosure (E)/

The apparatus consisted of a clockwork-driven ballistic cam (Kurvenkörper), which had the shape of an Archimedian spiral but was three dimensional, rather than lying in a single plane. The surface of this cam was followed by a rider, which transmitted electrical data to an electromotor control valve on the T-Stoff regulator. The correctness of this precalculated control system was balanced against an electrical accelerometer and a fuel volume-weight measuring device, which shifted the height at which the rider was to follow the cam. Drawings only were given to the Soviets. [redacted]

1. [redacted] Comment. Traenenstoff or tear gas.
2. [redacted] Comment. Code name for a type of rocket fuel.

Enclosures:

Enclosure (A) - Test Stand for T-Stoff Decomposition Catalyst with Legend
Enclosure (B) - Proposed Lead Oxyde Catalysts Sleeve for T-Stoff Test Stand
Enclosure (C) - Hypergolic Fuels Ignition Lag Apparatus with Legend
Enclosure (D) - Drift Corrector
Enclosure (E) - Thrust Regulator

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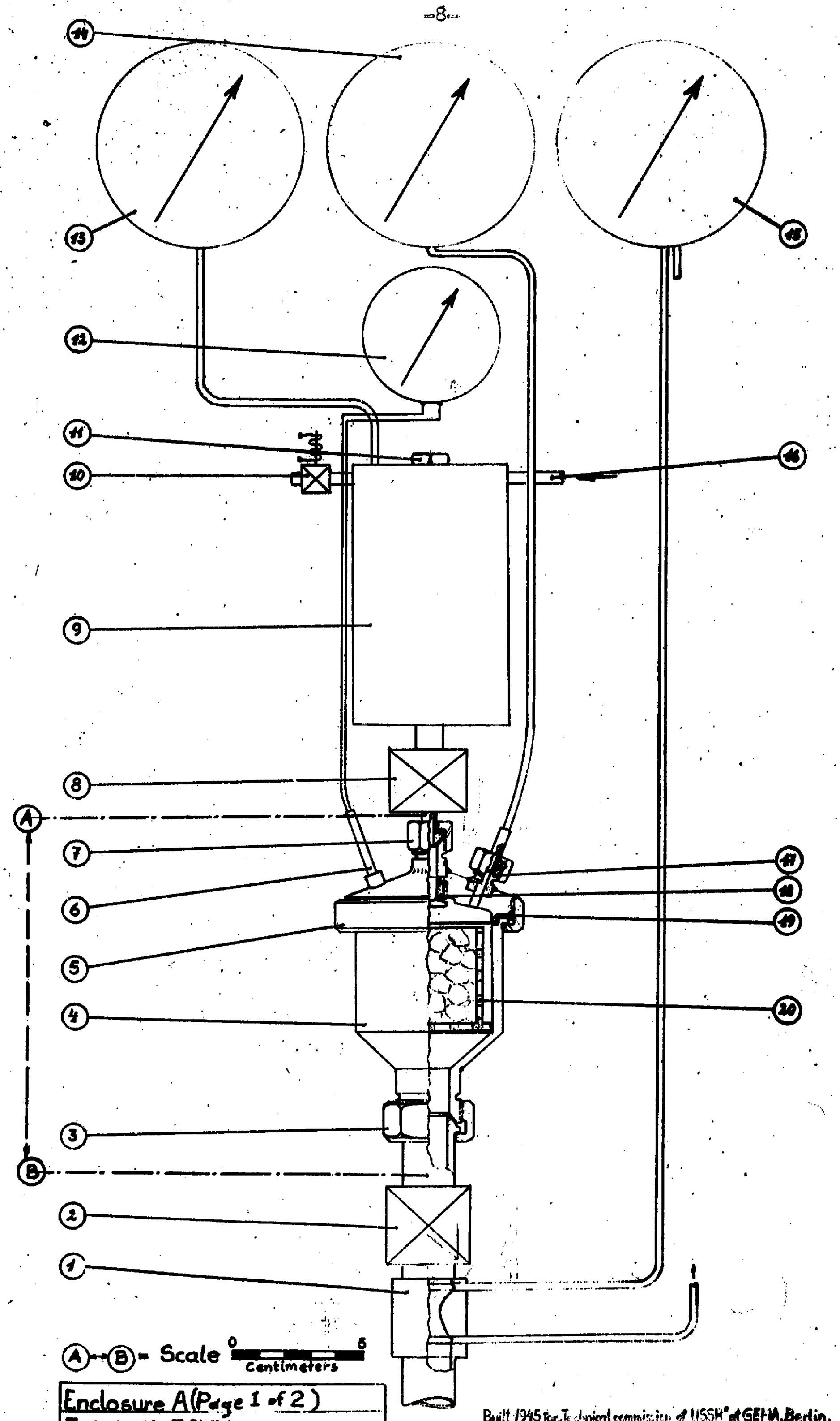

Enclosure A (Page 1 of 2)

Test stand for T-Stoff decomposition catalysis

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LEGEND

TEST STAND FOR T-STOFF DECOMPOSITION CATALYST

1. Differential Venturi
2. Pressure Control Valve
3. Chamber Disconnecting Nut
4. Decomposition Chamber
5. Chamber Cap
6. Nickel, Nickel-Chromium Thermocouple
7. Upper Disconnecting Nut
8. Quick-Opening Valve
9. T-Stoff Tank, 6 Liter Volume
10. Electrical Deventilating Valve
11. Filling Cap
12. Temperature Gauge
13. Tank Pressure Gauge
14. Chamber Pressure Gauge
15. Venturi Differential Gauge
16. Constant Pressure Air Inlet
17. Pressure Gauge Disconnecting Nut
18. T-Stoff Difuser
19. Gasket
20. Removable Sleeve

ENCLOSURE (A)

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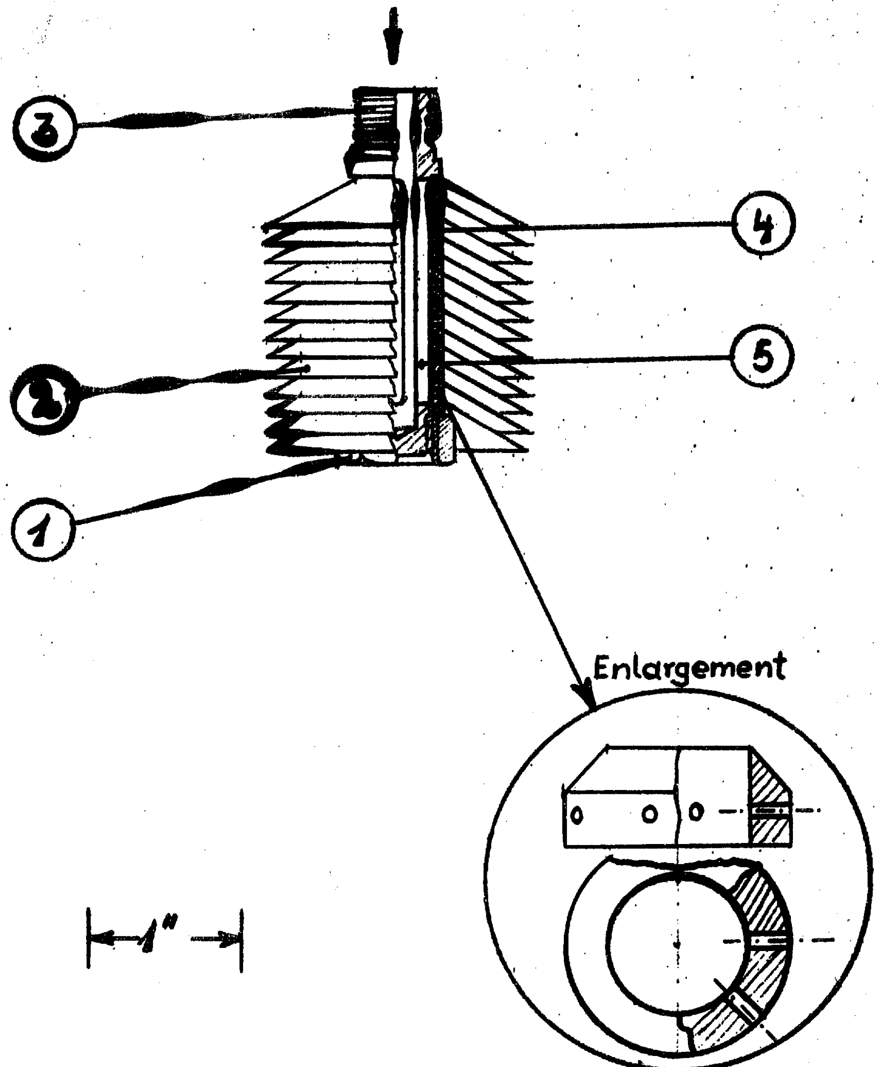

Enclosure B (Page 1 of 1)
Proposed lead oxyde catalysis sleeve for T-Stoff test stand
Legend: 1. Disassembly Nut 2. Iron Cones 3. Connecting Nipple 4. Diffuser Rings 5. T-Stoff Conduit

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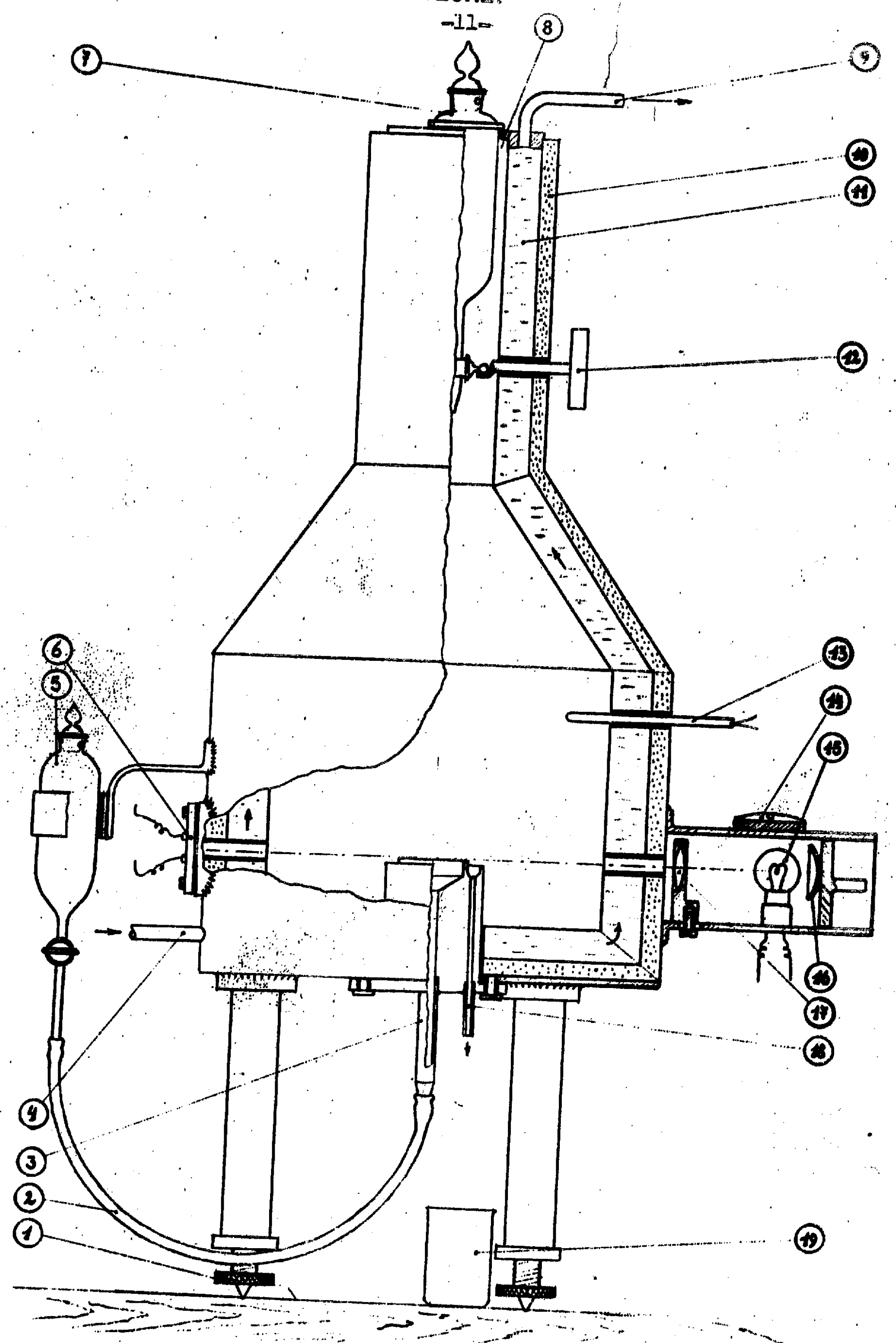

Enclosure C (Page 1 of 2)
Hypergolic fuels ignition lag apparatus
Scale: 0 5 cm

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LEGEND

HYPERGOLIC FUELS IGNITION LAG APPARATUS

1. Leveling Lug
2. Mipolam Hose
3. Fuel Pan & Tube
4. Constant Temperature Fluid Input
5. Fuel Container
6. Selenium Photoelectric Cell
7. Oxidizer Container
8. Ventilation Holes, 3 mm. Dia.
9. Abfluss, Constant Temperature Fluid
10. Silica gel Insulation
11. Fluid Jacket
12. Oxidizer Stopcock Handle
13. Nickel, Nickel-Chromium Thermocouple
14. Bubble-Center Leveling Device
15. 12 Volt Electric Lamp
16. Reflector Mirror
17. Condensing Lens
18. Fuel Pan Overflow
19. Glass Beaker

ENCLOSURE (C)

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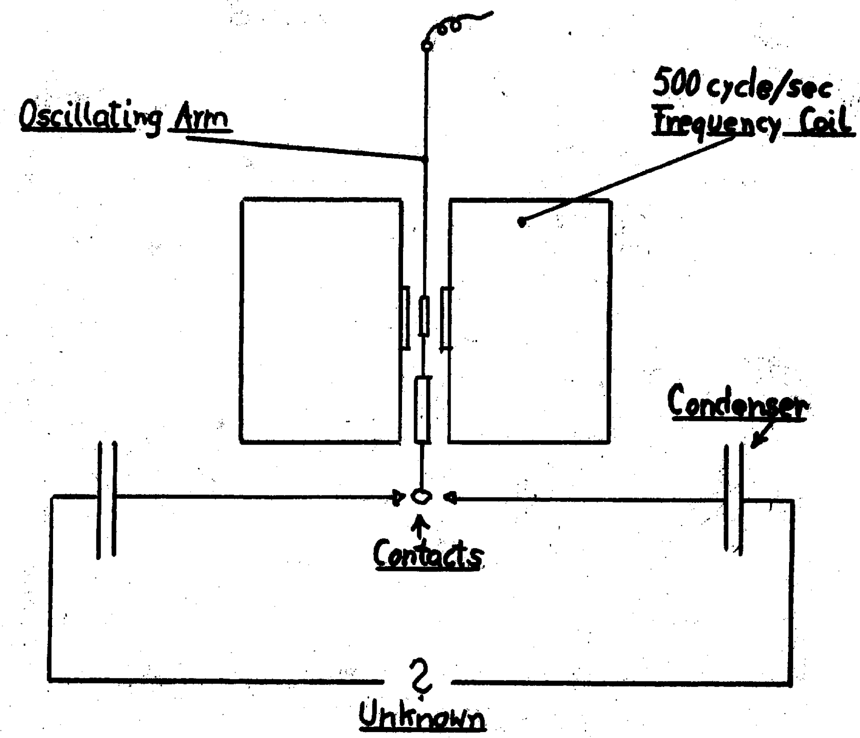

DRIFT CORRECTOR
Built by AEG 1944

Enclosure (D)

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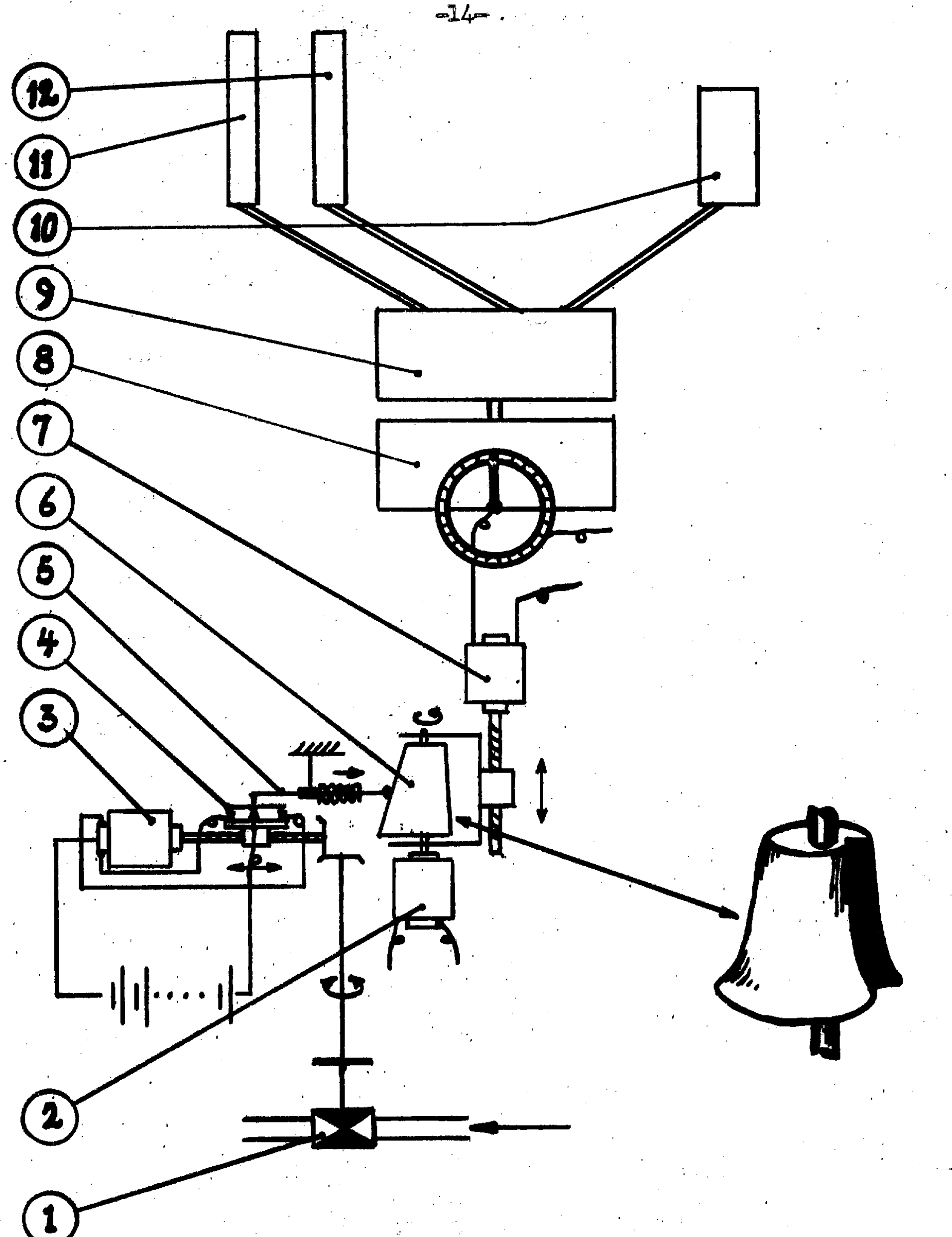

1= T-Stoff Steam Regulating Valve
2= Synchronous Motor
3= Reversable Electric Motor
4= Contact Bridge
5= Rider
6= Ballistic Cam
7= Cam adjusting Motor
8= Control Mechanism for #9
9= Computer & Amplifier
10= Accelerometer
11= Oxygen Measuring Gauge
12= Fuel Measuring Gauge

THRUST REGULATOR

Enclosure (E)

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